REPORT

OF

COMMISSION OF INQUIRY INTO DISCHARGE OF CYANIDE AND OTHER NOXIOUS SUBSTANCES INTO THE OMAI AND ESSEQUIBO RIVERS

5TH January, 1996

TABLE OF CONTENTS

INTRODUCTION

The Commission was appointed on the 7th October, 1995, and its terms of reference are appended to this report.

Shortly after its appointment the Commission met and decided that in order to permit for persons and organisations to submit memoranda it would commence public hearings on the 24th October, 1995, at the Ocean View International Hotel. The secretary was instructed to cause notices to be published in the media informing of the appointment of the Commission, the venue for its hearings and its terms of reference, and inviting the submission of written memoranda on or before the 24th October, 1995. The contents of this notice were later modified to intimate that the need for a written memoranda was optional.

The Commission commenced its work on the appointed date at the Ocean View International Hotel where it held sittings between that date and the 18th December, 1995. On the 16th November, 1995, the Commission journeyed to Bartica where it received evidence from twenty-eight (28) witnesses. The Commission also paid two (2) visits to the mines and milling facilities at Omai, the first being on the 25th October, 1995, and the second on the 20th December, 1995, after the oral hearings had been completed. During its sittings and its visits to Omai, the Omai Gold Mines Limited (OGML) spared no efforts to comply with any requests made of it by the Commission.

Apart from those who testified at Bartica, the Commission received evidence from thirty-nine (39) individual and eleven (11) groups and organisations.

Among the groups and organisations were the three specialised Committees that the Government had appointed to undertake indepth investigations into specific areas of concern. These are, the Dam Review Committee, the Process Review Committee, and the Environmental Audit and Socio-Economic Committee.

Also giving evidence were the Guyana Human Rights Association, the Guyana Consumers Association, the Guyana Environmental Monitoring and Conservation Agency, the Bretton Woods Reform Organisation, the Amerindian Peoples Association, the Guyana Council of Churches, the Islamic Trust and the Working Peoples Alliance and the geotechnical engineering company, Knight Piesold Limited, that was responsible for the construction of a part of the initial stage of the dam.

BACKGROUND

Omai Gold Mines Limited was incorporated on the 15th day of August, 1991. It is owned by Cambior Limited which has a 65% shareholding, Golden Star Resources Limited, which has a 30% shareholding and the Government of Guyana which owns 5%. On the day following its incorporation, ie. the 16th of August, 1991 the company entered into a Mining Agreement with the Guyana Government to mine for gold and other precious metals as well as diamonds in an area comprising 11,232.05 acres in the Omai River basin and catchment. Prior to this Agreement its two principal shareholders, which are Canada owned and registered companies, had undertaken analyses of the feasibility as well as the environment and socio-economic impacts of the proposed venture. The results of these studies are reflected in a Feasibility Study report of December 1990 and an Environmental Impact Statement (EIS) of January 1991.

Before the agreement between the parties was finalised the Government of Guyana, which clearly did not possess the expertise to pronounce upon the adequacy of either document, sought the help and later obtained the approval of the Commonwealth Secretariat of their contents. And both documents have been expressly incorporated into and form part of the Mining Agreement between the parties. In pursuance of the agreement the mill was built and the pond constructed, and the company commenced full production of gold in January, 1993.

Later in this report we shall examine in some detail the processes used in the extraction of the gold. For the present, suffice it to say that cyanide is an essential component of the extraction process and in the period of the company's operation before the August breaches , its consumption was as follows:

YEAR	TONS MILLED	KG CN PER TON
1993	3,888,963	0.708
1994	4,680,589	0.540
1995 up to 19th August	3,041,210	0.440

After the gold is extracted, the residue, the effluent or slurry or tailings, is conveyed by pipe into the tailings pond which had been constructed in a valley portion of a creek, the Captain Mann Creek, which is a tributary of the Omai river.

The water to start up the milling operations was all obtained from the Omai river, but the continuing milling process included the recycling of the free water from the tailings pond to the mill. In fact, for its continuing operation between seventy and eighty percent of this water was recycled. And although some

evaporation of the water in the pond, due to sunlight takes place, - (about 1250 mm per year) - there is a net accretion to the water balance because of the high level of rainfall - (2600 mm per year) - and run off from surrounding areas. Hence the water balance in the pond was expected to rise; and the original Environment Impact Statement (EIS 1991) made provision for the eventual decanting of the excess water from the tailings pond into the Essequibo river.

As regards the concentration of cyanide it was estimated that at the point of release from the mill this would be 28-32 parts per million (ppm). In the pond it would be exposed to the ultra violet rays of the sun which would degrade the cyanide content over time to 8-10 ppm. Thereafter, the water would be pumped into a nearby aeration pond where it would be further degradated by the use of jet sprays and further exposure to sunlight. The ultimate expectation was that the final cyanide content would be reduced to 2ppm. It was only then that the water would be released into the Essequibo river and then by means of a multiple port defuser. It was envisaged that that device, coupled with the massive flow of that river, averaging 14000m^3 per second would reduce the cyanide content in the river at the point of discharge to below the US and Canadian maximum standards for drinking water - 1.5 ppm and 2 ppm, respectively - and even the more stringent WHO standard of 0.07 ppm.

However, before the commencement of milling operations in 1992, the company proposed, and the Government regulatory authority, the Guyana Agency for Health, Education and Food Policy (GAHEF) approved of modifications to the original EIS 1991. For present purposes the main changes were:

1. The use of a gravity concentration circuit for extraction of heavier particles of gold thereby reducing the amount of cyanide used in the mill.

2. The resultant lessening of the cyanide concentration in the effluent released to the tailings pond would obviate the need for release of free water into the Essequibo river, for the first three years after the start up of milling operation.

Except that the aeration pond was never used for its stated purposes, the EIS 1991 as modified in 1992 of the agreement between the Government and the parties together with the contents of the Feasibility Study formed the bases on which mining and milling operations commenced in January 1993. Except for a mishap in May 1995, to which detailed reference will be made later in this report, operation at the mine and mill continued without any major incidents until the happening of the 19th to 24th August, 1995. But in the meanwhile, in March, 1995, the company sought official approval for a further modification of the 1991 EIS and the 1992 Addendum. It was to authorise the immediate subaqueous release of effluent from the tailings pond into the Essequibo river, with a cyanide content of 8 ppm at the point of discharge, instead of 2 ppm as contemplated in the 1991 EIS. The rate of discharge was estimated to be 600m^3/hr for 20 hours/d. during the remainder of 1995 and an increased discharge rate of 700m^3/hr during the following year. This request was motivated primarily by the fact that the company was reluctant to raise further the level of the dam from its elevation of 534m and the projected increase in the throughput of ore to the mill in 1996.

A Committee was set up headed by Dr. Walcott to examine the implications of this requested change. It advised against granting approval. And so water and other substances continued to build up in the tailing pond.

PREVIOUS DISCHARGE AND EVENTS OF THE 19TH TO 24TH AUGUST, 1995

Some evidence emerged before the Commission of a previous spill in May of 1995. This was as a result of a negligent omission to close a pipeline valve, which was intended as a safety device for taking excess water away from the mill. It remained open for several hours before discovery with consequent overfill of the sedimentation pond and discharge into the Omai river. There were fish killed and what emerged out of the incident was a heightened sense of the need for a more comprehensive emergency response procedure, which was in fact, prepared after much consultation and debate. The discharge, however, bears no relevance to the later events of August, 1995.

It was approaching midnight following a meal break. There was work going on to the outer perimeter of the transition zone; that is to say, on the rockfill. Waste rock was being spread. It was taken there by trucks. On one such trip the driver changed route and observed a flow of water at the outer base of the rockfill on the downstream side of the transition zone. He raised the alarm. His impression was that the dam had broken away. Merely an hour before a truck had passed the area and nothing unusual was observed. The breach therefore was sudden and serious. Mr McLean, Human Resources Manager, was informed.

The response was prompt. Senior personnel gathered and a series of decisions were taken, the most immediate being to divert the flow of water, which by then had become substantial, to the Fennel pit. Its natural course was to the south west into the mill ponds which soon overflowed into the Omai river. The

work commenced with dispatch. Staff and equipment from the Fennel pit were removed. A channel was dug across a road to take the flow away towards the east and south into the main pit.

Not surprisingly there seemed to have been no emergency response tailored specifically for such a massive outflow of tailings effluent. The evidence was, that a bulldozer operator worked throughout the night in the Channel being dug as effluent flowed past and around his machine, without any protective gear. He had no mask, no gloves, no special boots or clothing for protection. He ought to be commended. In mitigation it can be said that no one could have anticipated such a major failure of the dam. It was only in May that the Company had formulated a policy position on environment contamination contingency. At best, in the events, the response would largely be remedial with appropriate response procedures, rather than one of containment. As indicated earlier the mobilisation of staff and equipment was within ten to fifteen minutes.

At any one time one third of the work force are off location. Those on site were removed from the immediate vicinity of the breach, apart from those involved in the emergency works going on. By 6:00 a.m., the workers were briefed on the situation. Before that, the assay lab had begun to analyse samples taken from the Omai and Essequibo rivers to determine the level of contamination. This continued for several days and is ongoing. The results to date indicate that, notwithstanding the red yellow plume in the river, which was merely indicative of the metallic content of the saprolite, no person was exposed to cyanide levels from the Essequibo river water above the 0.2 mg/l (0.2 ppm) accepted Canadian guideline for drinking water. For Bartica and other riverain

communities, the water never exceeded the most stringent accepted guidelines for cyanide published by the World Health Organisation of 0.07 mg/l (0.07 ppm). The maximum concentration was measured by Omai to be 0.031 mg/l and by the Institute of Applied Science and Technology (IAST) at 0.016 mg/l. This may be explained by the fact that the Essequibo has a flow volume of 14 million m^3 (cubic metres) per hour. The mixing caused by rapids, added to the dilution factor, contributed to the minimal concentrations referred to above.

The Omai river downstream of the site was severely affected by the discharge. Many dead fish were sighted following the spill. The cyanide and heavy metal levels have since been reduced by a clean up campaign, to compare favourably with accepted guidelines.

Following the breach at around 11:45 p.m. the entire operation of Omai, and more particularly the mill, was shut down. The water pumps receiving water from the Omai river were locked out. On the 22nd August, 1995, the Company forwarded a formal report of a 'major seepage' to the Guyana Geology and Mines Commission.

The cutting of the ditch across the roadway to divert the flow into the Fennel pit had been completed by 1:30 a.m. on the morning of Sunday, 20th August, 1995. It succeeded in stopping the flow of water into the mill ponds completely by 2:30 a.m.. It was around 2:00 a.m. that the second and perhaps more serious breach was discovered to the north end of the main dam. That flow was directly west through a gorge into the Omai river.

There was no mobilisation of equipment to deal with the second breach. The management considered nothing could be done to seal it. The focus seemed to have been on the emergency standing operating procedures and the Environmental

Emergency Response Programme. Both were implemented. A security detail was sent into the riverain areas to advise miners and inhabitants against the use of water from the river and a more expansive sampling regime was implemented. The Prime Minister was contacted by telephone at 4:20 a.m. and informed. The Commissioner of Guyana Geology and Mines Commission could not be reached.

On the 20th August, 1995, three groups of officials visited the site including the media. The Company moved to a campaign for monitoring environmental impact. This was supplemented by one initiated by the Office of the President. The problem of the northern breach was then more fully addressed. It was agreed that a coffer dam be built across the gorge to stem the flow at that end into the Omai river. That structure however was not started until the morning of the 22nd August, due to difficulty in accessing the site, and was completed on the 24th August, 1995, effectively arresting the flow rate from 65,000 to 45,000 cubic metres per hour. The flow was wholly contained by 3:00 a.m. on the 24th August, about 100 hours after its commencement. By then 4.2 million cubic metres of tailings water had escaped from the pond, of which just under 2.9 million cubic metres had flowed into the Omai river, with the remainder contained behind the Coffer dam, and in the Fennel and Wenot pits and mill ponds. This means that about 1 million cubic metres of water remains in the pond. A clean up protocol was prepared for the Omai river and completed by the middle of September, 1995.

It would appear that a significant portion of the saprolitic core of the dam was washed away as a result of the dam failure, and as a result extensive cracks appeared in the crest along the entire length of the dam. An extensometer

was installed to measure the movement of the dam across the cracks between the stable position, and that part of the dam that was moving, and the rate of movement was measured early that morning at about 100 mm per hour. The dam was not designed to move at all. Its movement was forward and upstream into the pond. The movement continued throughout the day and then stabalised.

There was evidence of some depressions in the rip rap leading into the pond which indicated that there was some flow of water going through the dam at those points with a loss of material. The location of those sink holes did not make it feasible for any of the equipment on site attempting to seal them.

Following the breach, and to its credit, OGML caused potable water to be distributed on a daily basis to residents along the river as far as Bartica, over 90 miles downstream. This continued on to the 30th August, 1995. As well, quite a few of those involved in fishing and other economic activities have been paid some compensation for losses incurred.

REACTION TO THE NEWS OF THE BREACHES IN THE DAM

Public reaction to the news of the massive and ongoing escape of millions of gallons of water out of the dam was predictable. The quantity and concentration of cyanide in the river was of no concern. What was of concern was merely the fact that the water contained cyanide. Etched in the memories of many must have been the macabre tragedy of Jonestown in 1978 when over nine hundred (900) persons died after ingesting lethal quantities of a cyanide contaminated brew.

To those whose very existence depend on the integrity of the Essequibo river, the reaction to the discharge was alarm, worry and fear and in some cases downright panic and terror. And the fact that the potentially poisonous contaminant had a distinctly different colour (reddish/pink) from the natural colour of the river only served to heighten unfavourable emotional reactions. In the country at large there was a mixture of shock, distress and anger that such a devastating incident should have been permitted to happen. Some even went as far as to advocate the cancellation of the Agreement with OGML and a confiscation of its assets.

The reaction of the Government was almost predictable. The President proclaimed the Omai and Essequibo rivers an environmental disaster zone and shortly thereafter on the 24th August in an unanimous resolution the Parliament endorsed that proclamation.

Among other resolutions that Parliament approved that day were that:

i) a Commission of Enquiry be established to determine the causes leading to the disaster and to make recommendations on preventative measures and modifications by OGML to minimise the exposure of the environment if unexpected unforeseen events occur.

ii) an environmental audit by a reputable and expert agency or group of agencies at the expense of OGML, be executed within the zone of (sic) influence to determine the extent of the clean up required.

iii) the commercial operations of the OGML remain closed in order to allow for the clean up, the environmental audit and the work of the Commission of Enquiry, and;

iv) these operations can only recommence on the basis of the recommendations of the Commission of Enquiry and the Environmental Audit.

THE IMPACT OF THE DISCHARGE

(a) CONTAMINATION GENERALLY

The contaminant consequences of the spill impacted both environmentally and economically. This was immediate and far ranging. The company and its employees, the other river miners, the riverain communities, fishermen, businesses, the national economy, were all affected.

The evidence as presented by the Environmental Audit and Socio Economic Committee (EASEC) was however referable only to an audit of the impact of the spill and did not cover an environmental audit.

What emerged in the course of the Commission's hearings was an equal concern for possible contamination of the river sediment by heavy metals, as there was for cyanide in solution, whether in its free form or complexed. The main form of metal cyanide complexes present in the pond were, ferrocyanide and cuprocyanide. These comprise 80% of the total cyanide present in the tailings water. The ferrocyanide complex is recognised as having a low order of toxicity. It does not liberate cyanide when acidified, for example, in the stomach, and is not metabolised to cyanide in the body. Similarly with copper.

Even though the Commission's terms of reference did not specifically extend to the possible impact of heavy metals on the environment as a result of the spill it feels constrained, nevertheless, to deal with the issue if only for the sake of completeness.

One of the main criticisms of the sampling regime was that analyses were performed only on the supernatant solution in the pond and near surface water in the river, and not on the fluid sediment referred to as slime in either, and which may possibly produce physical and physiological effects on aquatic life, and impact on the ecology of the area.

The Commission has had no positive evidence that heavy metal pollution poses a serious problem to the environment. Indeed, as the Audit Committee points out, it was difficult to draw any conclusion based on data collected on heavy metals in river sediments, since upstream samples in the Essequibo river above Omai river indicated a comparable amount to downstream sediment samples. It should be noted, however, from tests conducted by independent bodies, such as IAST, that samples collected upstream from Omai in the Essequibo river, and downstream, showed relatively high levels of zinc, copper and iron in the sediment, which suggests that contamination may not be as a result of the spill but rather that these metals may be naturally present in the soil in high levels. The red yellow plume of the escaped effluent was very indicative of the metallic content of the saprolitic core of the dam which was washed away.

During and after the spill, surface and subsurface water samples were taken from the Omai and Essequibo rivers by OGML, the Environmental Unit, Office of the President (EU/OP), the Environmental Studies Unit, University of Guyana (ESU/UG), and the Audit Committee. The highest concentration of cyanide was 16.56ppm recorded by OGML on the 21st of August, in the Omai river. Samples taken of the same location on August 31st showed that the concentration had dropped to .004ppm. Samples collected by EU/OP (GAHEF) on August 29th, showed low

concentrations of cyanide in samples taken between Bartica and Parika. By August the 31st there was no detectable presence of cyanide in the samples collected in the Essequibo river.

The analysis of water samples taken after the spill on September 20th and October 15th by EU/OP showed traces of cyanide in samples collected in the Omai river which the Committee felt may have been from the release of cyanide from river bed sediments or from other unidentified sources. The Omai river water is now back to its natural dark colour and further samples taken at three points on the 20th of November did not detect the presence of cyanide on analysis.

It may be pertinent to point out that results of analyses of dissolved metals in the Omai river at a location downstream near the aeration pond, just below the point where the effluent entered the river, when compared with baseline data as reported in the 1991 Environmental Impact Statement (EIS), at the same site, showed no significant changes in dissolved metals, such as copper, iron and lead, even though concentrations have fluctuated since the spill. The lack of baseline data for other locations in the Essequibo river downstream from the mine does not allow a similar comparison but, as indicated earlier, the upstream data suggest a similar situation

Generally, water quality analyses for the Omai and Essequibo rivers indicated the following:

(1) very high concentrations of cyanide, iron and copper in the Omai river during the spill;

(2) concentration of total cyanide decreased with distance from point of discharge as a result of increase in dilution and degradation;

(3) cyanide concentration decreased with time;

(4) results of the various laboratories (OGML, Cariri of Trinidad, Envirotech and (IAST) showed a clear correlation in results even though different laboratories had different absolute values for each laboratory. Though different these are acceptable; and

(5) Dissolved metals concentrations did not change significantly after the spill dissipated even at the location downstream in the Omai river.

(b) ON AQUATIC LIFE

Aquatic life was affected over the entire length of the Omai river with 346 dead fish collected. Cyanide and heavy metal levels reported were at the highest in that river.

The lack of baseline data on aquatic life in the Omai river makes it difficult for a quantitative analysis to be done on the full extent of the damage as a result of the spill. By September 20th, following OGML's clean up of the bank and river bed, live fish were seen in the vicinity of the point of impact where the effluent entered the Omai river. This suggests that the river's bacteriological and biochemical capacities were not severely affected, thus allowing for the gradual restocking of fish.

There was no evidence of any impact on the aquatic life in the Essequibo river, as a result of cyanide or metals toxicity. The significant reduction in cyanide levels downstream, most probably by the dilution effect of its flow volume, and velocity, and the natural degradation of cyanide complexes, resulted in no observed or reported fish death. It was the Audit Committee's opinion that even though for a short period (August 20th - 25th) the metals and cyanide levels

were above USEPA chronic criteria standards for fresh water aquatic life, the short period of exposure should not have any effect on these organisms. Samples collected on the 20th September and 15th October all indicated concentrations of heavy metals below USEPA standards, and since samples taken upstream of impact showed similar levels, their presence could hardly be attributable to the spill. It is not expected, therefore, that these metals would bio-accumulate in aquatic life. We feel that the upstream sediment analyses should adequately meet the concerns of those who perceived a threat to the environment by heavy metals. Additionally, bore hole sampling results in the vicinity of the pond, do not indicate any significant seepage into the ground water systems. It should be borne in mind too, that OGML had been sampling and testing its well water from site, and these did not show the presence of cyanide.

(c) IMPACT ON HEALTH OF WORKERS AND RIVERAIN RESIDENTS

Before, during and after the spill, there had been no reported cases of cyanide or heavy metal poisoning among workers of OGML notwithstanding exposure and contact with effluent at its highest concentration during the spill. Its medical centre is well staffed with a resident medex and operates on a 24 hour basis. A non-resident medical officer provides supervision, advice and medical attention.

In the river, communities were visited to assess the health effects resulting from the spill. There were two (2) reported cases of suspected poisoning made to the Regional Health Officer, Dr J. Westford, of Bartica, one was a known hypertensive with symptoms of a transient ischaemia attack (transient stroke) and the other a patient with mild gastro-enteritis. One complaint of impotence turned out to be a case with the AIDS disease.

Many complaints were made to the Commission and the Audit Committee of symptoms which the complainants attributed to the contaminated water; as well as skin irritations, burning and pealing of the skin, pain in the chest, redness of the mouth, and nervousness. These latter were all non-specific and not suggestive of cyanide poisoning. A review of the in-patient and out-patient statistics for Bartica and the riverain communities was done and a comparative analysis made of pre-August and post-August patients seen with skin problems. There was no appreciable rise in the number of cases. Indeed, more skin problems were seen in February. The problem could hardly be attributable therefore to the contaminated water. Indeed, other residents, including the doctor herself, (the RHO) came into contact with the water and did not develop similar symptoms.

We have come to the conclusion that at no time was the contaminated water a serious threat to life. Nor was there any credible evidence that the spill in any way posed a hazard to the health of OGML workers or the riverain residents.

(d) THE SOCIO-ECONOMIC IMPACT

On households

The population of the river is estimated at 10,000, the highest concentration of 8,000 being at Bartica. There are approximately 875 households and businesses. Again the highest concentration of 504 is at Bartica. The main effect of the spill was in potable water supply. Residents immediately discontinued the use of river water for drinking and washing. The food supplies of 33% of households were also affected. The use of fish and meat from the area was discontinued. Supplies from Georgetown proved expensive.

A survey by the Audit Committee generated information on health, drinking water, fishing, logging, farming and the social and economic well being of the affected communities. Many questions were of the multiple choice nature. The data collected was clarified for computer processing.

The results of the survey indicate that the aggregated loss for households across the thirteen (13) areas surveyed was $198,000.00 (One Hundred and Ninety-eight Thousand Dollars). Agatash about three (3) miles upstream from Bartica seemed to have suffered the most, with aggregate losses of $120,000.00 (One Hundred and Twenty Thousand Dollars) followed by Lanabali $60,000.00 (Sixty Thousand Dollars) and Fort Island $18,000.00 (Eighteen Thousand Dollars). No other households were affected.

On businesses

Aggregated business losses along the river was $14,104,000.00 (Fourteen Million One Hundred and Four Thousand Dollars). Thirty-five (35) businesses were interviewed. The highest aggregate claim of $8,299,600.00 (Eight Million Two Hundred and Ninety-nine Thousand Six Hundred Dollars) came from Bartica followed by Lanabali of $3,600,500.00 (Three Million Six Hundred Thousand Five Hundred Dollars) and the Alphonso's Mining Camp with $1,260,000.00 (One Million Two Hundred and Sixty Thousand Dollars). Shankland, a holiday resort, suffered a loss of $196,000.00 (One Hundred and Ninety-six Thousand Dollars). The Commission is of the view that many of these claims were dubious and if not, were highly inflated.

There was a loss of exports to Caricom and other countries as a result of a ban imposed on Guyana seafoods. The loss of foreign exchange earnings was computed at $18,776,060.00 (Eighteen Million Seven Hundred and Seventy-six Thousand and Sixty Dollars) over a 14 day period.

Logging, agricultural and quarrying activities were all indirectly affected by the spill. The workers refused to enter the water. Fishing activities in the river, especially at Lanabali ceased. In most cases there was restitution made to fishermen by OGML for losses sustained.

On economy

The loss to the economy from cessation of mining operations at OGML was significant. Royalty lost to Government amounted to G$20,854,500.00 (Twenty Million Eight Hundred and Fifty-four Thousand Five Hundred Dollars). The accumulated value for projected months of October to December for Customs Duties was G$11,604,274.00 (Eleven Million Six Hundred and Four thousand Two Hundred and Seventy-four Dollars). The average monthly Income Tax lost for workers was G$305,508.00 (Three Hundred and Five Thousand Five Hundred and Eight Dollars) with NIS G$8,727.00 (Eight Thousand Seven Hundred and Twenty-seven Dollars) per month.

The estimated loss of income to workers was G$560,757.00 (Five Hundred and Sixty Thousand Seven Hundred and Fifty-seven Dollars) to the end of December. So that the grand total of loss to the national economy was G$426,139,154.00 (Four Hundred and Twenty-six Million One Hundred and Thirty-nine Thousand One Hundred and Fifty-four Dollars) of which the Government's share in Royalties, Customs Duties, Income Tax and NIS would have been G$314,565,014.00 (Three Hundred and Fourteen Million Five Hundred and Sixty-five Thousand and Fourteen Dollars).

The Commission did not hear any evidence of a quanitifable loss in terms of local services and goods provided by independent contractors to OGML. This figure is most probably significant.

CYANIDE USE - AN EMOTIVE ISSUE

The mere mention of the word cyanide seems to generate fear and revulsion in the mind of the average person. Little is it known that the chemical is to be found in many items of food that are in everyday use. For example, it is to be found in the seeds of apples, in peaches and plums, pears and cassava and its by product and in cigarettes. Additionally it is used in the manufacture of such household products as silver polishes, insecticides, rodenticide; and then there is its widespread use in industry and more especially in those concerned with the extraction of metals such as gold and metal recovery. Although its use in the mining industry dates back over one hundred (100) years, conventional wisdom still recognises it as the most economic means of gold extraction that is environmentally acceptable. Indeed there is unanimity among those who testified before the Commission that over eighty percent (80%) of the gold mining industry employ this means of extraction. All acknowledge the benefits that have accrued worldwide from the mining of gold and other precious metals. But the conservatives among us say that the potential hazards of the use of cyanide for this purpose pose too high a risk and that it should therefore be prohibited. Others say that if it is to be used at all, none of it should be discharged into the environment, and yet others, while acknowledging the risk inherent in its use, say that it can be nonetheless properly managed.

The Commission has no doubt that the gold mining industry can act as a catalyst for the country's progress and overall development, and that in order to realise the full potential of this sector, the way forward is not to ban the use of cyanide but rather to carefully manage and monitor its use.

Cyanides are a group of substances based on a common structure when an atom of carbon and an atom of nitrogen combine. And hydrogen cyanide is a compound of hydrogen and cyanide. Total cyanide in the tailings pond comprises free cyanide, weak acid dissociable cyanide and complexed cyanide.
Free cyanide which makes up 20% of the total cyanide is the most potent, weak acid dissociable cyanide is cyanide that is complexed with such metals as nickel and lead whilst complexed cyanide is cyanide that is complexed with such metals as copper, zinc or iron.

Cyanide can enter the body through the skin, the respiratory tract, and the gastro intestinal tract. To be fatal a human must ingest - and this is the same for animals - a concentration of 1-3 mg of the chemical per kilogram of body weight or in the average adult 34 mg. At this level of ingestion the reaction is rapid. Sub-lethal doses (whether of free or complexed cyanides or weak acid dissociable cyanides) if ingested are expelled by the body, but free cyanide is by far the most potent. Chronic (long term) exposure to lesser quantities can result in abnormalities in the thyroid, folate and Vitamin B metabolism as well as peripheral nerve damage.

Fish do not drink water. They absorb what is in the water through their gill membrane. Because of this, they are more susceptible to cyanide toxicity than humans. This is due to the fact that the cyanide transfers directly into the blood stream through the gills.

In the absence of any research into the effect of cyanide on tropical fish the best that can be done is to adopt the experiences of the temperate countries where much research has been done on its effect on the rainbow trout. From these

experimentations it has been determined that the lethal concentration is 0.045 mg/l (ppm) of free cyanide and the maximum non-lethal standard has been set at 0.005 ppm.

The goal should be to set our own standards, but this, besides being costly, would involve much time and experimentation and until this can be attained the WHO standards, to which we have alluded, should be adhered to.

PROCESSES IN THE MILL - THE 1992 ADDENDUM

As we have already stated, among the most common industrial uses of cyanide is in the recovery of metals and more particularly in the extraction of gold and silver from hard rock or other ore.

The original production target of OGML was fixed at a throughput of 12,000 tons (13500 tonnes) of ore per day. The raw material used comprised a mix of hard rock and saprolite. The hard rock is crushed and together with the saprolite is leached in a cyanide solution. This cyanide solution dissolves the gold particles embedded in the ore and these are adsorbed onto activated carbon columns which are subsequently stripped of the gold and regenerated. Thereafter the refining process takes place.

The Commission has had the benefit of reading the report of the Process Review Committee and has heard the oral testimony from two of its members. We fully endorse that portion of the Committee's report as it relates to the milling processes, and in this regard the Commission can do no better than to reproduce and adopt the relevant portions of the report.

"The mill at Omai is central to the concerns of the Process Review Committee, since the tailings originate here and the cyanide used to dissolve gold is added during treatment. The milling process begins with crushing, which is done dry. All hard ore must be crushed, and a portion of the softer saprolite ore is put through the crusher to facilitate materials handling.

Crushed ore and the balance of the saprolite is fed to a semi-autogenous (SAG) grinding mill. This is a wet process, and cyanide solution is added at this point. The SAG mill discharges to one of two vibrating screens, and the pebble oversize (about 30 percent of the new feed) is sent to a cone crusher, crushed and returned to the SAG mill.

The SAG mill screen undersize is pumped to cyclones arranged in two banks of six each. Five-sixths of the underflow (coarser material) goes to ball mills for fine grinding, and the underflow from one of the six cyclones is diverted to gravity concentration on Reichert cones, spirals and a finishing table producing a final gold concentrate amounting to about one-third of the total recovered.

The cyclone overflow, fully ground, is taken to a thickener which was originally intended to produce a thickened underflow for leaching, and a relatively clear overflow to be recycled as process water. In practice, the overflow was too high in solids, and in January, 1995, OGML installed an Eimco E'Duct system on the thickener. The new system has resulted in a much cleaner water for recycle, as well as improved density of 45 to 50 percent solids in the underflow going to leaching.

The leaching section at Omai is a standard carbon-in-pulp system in which the feed is first leached in agitated tanks, and then passed through a separate series of tanks, moving countercurrent to carbon which adsorbs the gold. Cyanide concentration at the leach tanks is 0.18-0.22 grams per liter (gpl) (180-220ppm), and ordinarily no additional cyanide is required. Free cyanide in the tailings stream runs 70-100 parts per million (ppm) or milligrams per liter, about one-third to one-half of the entering concentration.

Omai ore is remarkably "clean" in terms of metals like copper, nickel and zinc which form soluble cyanide complexes.
Soluble iron in the system can also form complexes with cyanide, but these complexes are insoluble. Any gold lost in solution, termed "solution loss", is also in the form of a cyanide complex. In the original plant there were only 5 Carbon in pulp (CIP) tanks, and solution losses were 0.03 to 0.05 grams per tonne, but a sixth tank was added, and solution losses fell to 0.02 - 0.03 gpt."

And as regards the proposed expansion of the company's milling capacity the Committee has this to say:

"Prior to the tailing dam failure, the Omai plant was treating about 12,500 tonnes per day, approximately 50/50 hardrock and saprolite. The feasibility study was based on a 75/25 ratio, but the original 30-foot diameter SAG mill had lower capacity for hardrock than anticipated. Because of this, the expansion will include a 32-foot SAG mill, raising the total hardrock capacity to 13,500 tones, of which the new mill will

handle 7,250 tonnes. The balance of some 4,000 to 5,000 tonnes per day will be saprolite, effectively changing the hardrock/saprolite ratio to about 75/25. Grinding and thickener operation should be benefitted accordingly.

The primary crusher will not be changed, although its hardrock feed will rise from 6,250 to 13,500 tonnes per day. According to the operators, the crusher will have to operate at least 18 hours every day, putting a premium on rapid, efficient maintenance. To facilitate this, the expansion program calls for more space on the feed floor and improved crane capacity to provide better and faster access for mantle and bowl liner changes. A larger rock fill will also be provided to improve handling of oversize pieces in the crusher feed."

The Commission also agrees with the Committee's assessment of the management facilities, viz, that both the mining and milling processes are well managed, maintained, and efficiently run. Further, the Commission views favourably the technology that has been put in place, viz the gravity concentration circuit, the effect of which has been to reduce the consumption of cyanide in the extraction process. However, members recognise that this gain would be offset by the proposed expansion of the milling capacity which would necessarily require increased imputs of cyanide, and therefore result in the release of larger quantities of the chemical into the tailings pond.

THE EFFLUENT

Effluent from the mill entered the tailings pond at the eastern end. It includes the residue of the crushed rock and saprolite and traces of such metals as, zinc, copper, aluminum, iron mainly in the form of cyanide complexes as well as free cyanide and other process reagents such as, flocculent calcium and nitric acid, together with water. In the pond some of the solids come to rest on the beach, but the bulk of the effluent finds its way into the western portion of the pond where sedimentation takes place as the heavier particles come to rest at the bottom. Above this one finds a layer of water and sediment and overlying this is clear water, with very little sediment. About eighty percent (80%) of this free water is later recycled into the mill after treatment and is added to made up water from the Omai river for continuance of the milling and extractive process.

The original plan, as set out in the 1991 EIS provided for the discharge of supernatant into the Essequibo river at a cyanide concentration of 2 ppm. It was intended that, this degree of degradation would be achieved by eventually transferring the excess water in the impoundment, into an aeration pond where it would be further degraded by means of aeration. Thereafter it would be discharged into the river by means of a four port diffuser located at the deepest section of the river's main channel. The purpose of the difuser was to induce a rapid mix of the pond water with the receiving water.

THE TAILINGS POND - EFFLUENT MANAGEMENT

The tailings dam sits astride the Captain Mann Creek towards its western extremity on a gradient approaching the Omai river into which it once flowed. It encloses a natural valley which forms the pond. A certain co-efficient of the storm water in the catchment area therefore runs off into the impoundment. The main portion of the dam runs north to south for about 800 metres then curves east at what is described as the transition zone for 400 metres and continues more or less in an easterly direction for about 800 metres to the southern abutment of the entrance to the valley. This southern portion of the impoundment is called the pit wing. This is in reference to the fact that that section of the dam separates the pond from the main stock or Fennel pit in which the rock ore is mined. The northern end of the dam ties into the natural northern abutment of the valley. On the downstream side of the dam was an area for dumping surplus waste rock and saprolite. In this area the engineering design indicates french drains for drainage.

The engineering design provided as well for a temporary diversion conduit about the centre of the main dam in the foundation, to allow the flow of the Captain Mann Creek. The embankment was being raised in phases .

At the time of the incident the dam was at elevation 534 metres. The impoundment capacity had been designed considering water balance parameters for annual extreme wet and dry precipitation periods and maximum storm events. Initially there should have been zero discharge over the first three years of the mine life commencing early 1993, but extreme precipitation probably necessitated

earlier discharge than anticipated. Presumedly the dam could not have been elevated fast enough to accommodate the rapidly increasing volume of effluent, with expansion of mill capacity.

Simply put, the dam was constructed sloping into the pond. Its upstream face consisted of riprap or coarse rock of 5 metres. Below this was a saprolitic core 25 metres in width. This rested on a bed of filter sand 2 metres wide, and further downstream was compacted rockfill, followed by the waste saprolite and rockfill dump which gave support to the entire structure. Within the saprolitic core were piezometers. These instruments monitored water pressure within the core. They were situated in the northern and southern sections of the main dam.

The design specification of the dam allowed a freeboard range of between 6.5 and 11.5 metres from the crest. On to elevation 534 metres, the freeboard ranged between 3-5 metres at all times, as Exhibit "iii" indicates. We have no conclusive evidence as to whether this was a contributing factor to the breach.

At any rate, piezometer readings over the period December, 1992, to May, 1993, indicated that there was water present in the rockfill, and, that it had risen by some 5 metres over that period. There is conflict as to whether this occurrence should have caused alarm bells. The issue was raised between the site engineer and Golder Associates Ltd., OGML geotechnical consultants, in August of 1993; the query being, what may have caused the sudden changes in the piezometric readings in the sand filter zone. At that time the dam elevation was at 510 and the pond at 506.014 metres. The response was that the data suggested the recent rise in the readings at the levels in the piezometers in the saprolite at A0-PE1-05 and B0-PE2-05, and in the sand filter at A3-PE1-01 and B3-PE1-01, were related to a common event. The most likely explanation was a rise in the

water levels downstream of the dam, as a result of disruption of the french drains by sheer movements associated with the waste dump downstream of the engineering fill line. We should imagine, that if there was no drainage the water had to back up somewhere. But OGML, perhaps not unreasonably relied on the advice of their geotechnical expert consultants. Peculiarly, the piezometers referred to above are not indicated on the diagram of piezometers in Exhibit "Q2" and "Q3". This issue will however be more fully addressed later in our report on the question of liability.

At the point of exit from the mill the cyanide content in the tailings could be as high as 150 ppm. But in the pond substantial natural degradation takes place because of the volatilisation of the cyanide when exposed to ultra violet rays. But there is an added reason for a reduction in the cyanide concentration in the pond. It is the net accretion to the water in the pond due to the excess of precipitation from rainfall over evaporation. But as we had already said this is one of the significant reasons for the need for release of excess water, that would accumulate over time in the pond, into the environment. A further reason is the engineering requirement that a stated freeboard, i.e., the distance between the crest of the dam and the level of the water, be maintained so as to ensure against over-spilling and to permit for raising the height of the dam as envisaged in the Feasibility Study.

But the 1992 addendum to the 1991 EIS, which was approved by GAHEF, provides for a significant departure from the plan of 1991. It proposed, as we had said, the incorporation into the milling process of a gravity concentration circuit which would permit for the recovery of coarse free gold from the ore feed slurry.

It was projected, and later production confirmed this, that approximately 30% of the gold in the feed would be recovered in the circuit. From an environmental standpoint this was expected to and did reduce substantially the cyanide consumption and hence the quantity of cyanide reporting to the tailings impoundment. This new dimension, together with certain other changes relating to the location of the spillway, and a diversion ditch around the southern perimeter of the base of the pond in order to intercept the Captain Mann Creek, neither of which was constructed, were intended to result in a zero discharge from the pond into the environment for a period of at least three (3) years. But by early 1995 this goal was proving to be too elusive and so a further addendum to the 1991 and 1992 EIS was proposed.

The 1995 EIS Addendum

Its primary purpose was to reverse the zero discharge projection in the 1992 addendum, and to win approval for the installation of a diffuser, although a larger one than that which had been envisaged in the 1991 EIS in the Essequibo river. The reason was because the water level in the pond had been rising at such a rate that by the end of June, 1995, it was anticipated that the free water would total almost 4,000,000m^3 and so exceed an elevation of 529m, which would have exceeded the maximum permissible water level when the dam crest was at elevation of 534m. An additional reason was that OGML had planned an expansion of the milling capacity to 18000 tonnes per day by 1996.

Aside from the natural breakdown of cyanide and metallo cyanide complexes in the tailings pond, the company proposed the further removal of cyanide in the activated carbon columns to be located in the mill complex; They, however, reacted negatively to a proposal to further reduce the cyanide concentration by treating the effluent in the tailings pond with hydrogen peroxide, giving as their reason "the inherent inefficiencies associated with attempts to treat relatively low levels of in-pond cyanide levels (as exists at Omai)."

In order better to advise itself as regards these proposals the Government appointed a Committee to examine them. The Committee found that the Company had intended to release supernatant into the Essequibo at a concentration of 8ppm instead of 2ppm set out in the 1991 EIS. It therefore advised rejection of the plan until that level of concentration had been achieved.

The New Pond

The Process Review Committee did consider the reduction of the cyanide content in the tailings pond and the Commission endorses the proposal that hydrogen peroxide be used as a further means of reducing the cyanide content in the free water.

The Commission also notes that the company plans to use carbon columns which they claim their tests confirm would not only lower the gold content in the supernatant that is released from the impoundment from 0.02-0.03 grams per ton to about 0.01 grams per ton, i.e., by about eighty percent, but also, "some fifty percent of the copper and twenty to twenty-five percent of the cyanide in the pond water". It should be noted, however, that the committee set up to review

the 1995 EIS addendum that OGML had sought approval of and which was headed by Dr Walcott, who was a member of the Dam Review Committee, was not convinced of the validity of this last claim concerning the reduction of the cyanide content.

Finally, the Commission notes that prior to its release into the environment the company proposes to treat the effluent in the pond with a three stage hydrogen peroxide oxidation plant for further cyanide oxidation. In this plant it is proposed to add a small quantity of copper sulfate as a catalyst. Thereafter the treated water will flow to a metal precipitation tank where ferrous sulfate would be added to coagulate the metal cyanides and hydroxides. The effluent will then flow into a clarifier which would separate the solids for return to the tailings pond. It is anticipated that the combined effect of these processes would be to reduce the cyanide and heavy metal content in the water at the end of pipe discharge point to 1.5 ppm and the total suspended solids to 10 ppm, and thereafter passing through the clarifier the cyanide concentration would be 0.005 ppm, copper 0.0065 ppm, zinc 0.59 ppm and iron 1.0 ppm, all of which are below the most stringent international standards. The Commission supports the introduction of these additional effluent management features plans and in particular notes that the clarification process is intended to remove discolouration from the water, a discolouration that in a large measure exacerbated the emotional reactions of the riverain populace.

Although there was not unanimity by the members of the Committee on certain issues the Commission is of the view that consideration should also be given to setting the maximum concentration of cyanide entering the tailings pond, and in this regard, support the minority opinion expressed by Mr Hocker, that as a

matter of urgency OGML should investigate and eventually introduce a system that would reduce the cyanide content of the tailings at the point of discharge from the mill. Not only would such a precaution result in a reduced concentration of cyanide being released into the pond, which is in itself a positive step, but it would also ensure that in the event of the recurrence of an August, 1995, incident, the effects on the environment would be minimised. But additionally, the supernatant that is later released into the Essequibo river after treatment with hydrogen peroxide and other chemicals would more readily conform to the cyanide concentration of not more than 2 ppm at the point of release.

Further, mindful of the initial difficulties of gaining access to the northern end of the dam of the defunct pond, the Commission is attracted to the suggestion that there should be access to any part of the new tailings pond by routes, so that at least one would remain open in the event of unplanned discharges, and that the downstream side of the dam should always be visible for inspection, and recommends its implementation.

The Commission also supports the need for its construction to be to the most conservative specifications. And finally, the Commission recommends that the Government engage an independent consultant at the expense of OGML to explore the economic viability of the use of other available technologies for the degradation of cyanide such as INCO, AVR, the FMC Caro Acid Process with a view to determining whether any of them can be adapted to the Omai conditions and requirements.

MANAGEMENT OF CYANIDE AND OTHER TOXIC MATERIALS

The extraction of gold by means of cyanide is a worldwide phenomenon. It clearly has its hazards, but the benefits to the Government and to the communities in which such enterprises operate far outweigh those hazards. What is of crucial importance in such environmentally hazardous undertakings which can bring substantial benefits to the community, is the proper management of that hazard. To walk away from the problems inherent in hazard management is to deny oneself the significant benefit that can accrue from the ultimate products. For it must always be borne in mind that lasting progress cannot be achieved without some modicum of hazard taking, and that humankind has never allowed the potentially negative effects that could result from hazardous undertakings to deter it in its quest for a progressive and more comfortable existence.

As regards the discharge of effluent from the tailings pond into the environment the Commission endorses the conventional wisdom that, because of our tropical environment, precipitation by rainfall would always result in a build up of water in any open impoundment such as a tailings pond, and notwithstanding the fact that substantial portions of that water are recycled for further use in the milling processes there would always be excess water in the tailings pond that must be released into the environment. The Commission therefore strongly recommends that the quantities and concentrations of cyanide and other potentially harmful substances be strictly controlled and for this purpose that a regulatory regime be put in place to monitor the implementation of any agreed protocol. This is clearly a governmental responsibility which at the present time is wholly lacking.

LIABILITY

(a) THE ISSUE OF CAUSATION

Possibly the most controversial issue that confronted the Commission is concerned with that part of its mandate which requires that it consider the question of liability. But before examining this issue we must address what, despite its submission somewhat late in the day, can only be described as a preliminary objection to the jurisdiction of the Commission to comply with that part of its terms of reference. It reads as follows:

"to receive representation upon and inquire into:

a) .....

b) the liability for the discharge and the consequence thereof."

The word "inquire" is defined in the Concise Oxford Dictionary to mean "to make, search into or to seek information about". The word "liability" means "person or thing that causes disadvantage through ones responsibility therefor". "To inquire into liability", in other words, must mean "to seek information concerning the blameworthiness of any person or thing". But counsel on behalf of OGML submit that because a Commission is not a court of law it could not purport to determine any legal relations among parties. Any purported exercise of such adjudicative functions would, they contend, be unconstitutional as being in violation of the separation of powers which is one of the cornerstones of the Constitution. We agree that the Commission is not a court of law and therefore can make no pronouncement for issues of liability that can bind anyone. But in our opinion this fact does not necessarily mean that the President does not have the constitutional power to appoint a Commission for such a purpose.

In exercising his power to appoint the Commission, inter alia, for that purpose the President was acting under s. 2(1) of the Commission of Inquiry Act, Chapter 14:03. This section empowers him to "appoint a Commission and authorise its members to enquire into any matter in which the inquiry would be for the public welfare". And under s. 13 - "any person whose conduct is the subject of the inquiry or who is in any way implicated or concerned in the matter under inquiry is entitled to be represented by counsel. In the opinion of the members of the Commission this latter provision contemplates that the President may appoint a Commission of Enquiry into matters which may result in implicating a person or persons in some form of blameworthiness, provided that the matter to be enquired into is for the public welfare; and therefore empowers the Commission to inquire into liability.

But, in any event, whether or not the Act empowers the Chief Executive to direct an enquiry as to liability, and whether or not he exceeded his constitutional powers is not for us to decide; and for the same reason that counsel would have us recuse ourselves from taking action. It is, that we are not a court of law and the vires of the President can only be determined in such a forum, and the Commission's functions are limited to carrying out the mandate which it has been given.

Evidence concerning the construction of the dam

The evidence about the dam came from Mr Stephen Vick, who was the Chairman of the Dam Review Committee, all the members of which are specialists in dam construction in the mining industry; Mr Charles Brawner, a Dam Specialist in the employ of OGML; and Mr Jeremy Haile the President of the Company, Knight Piesold Limited, which were involved in the initial stages of the construction of the main dam.

Knight Piesold Ltd. of Vancouver, Canada, is one of a series of interconnected companies which function in various parts of the world. They are geotechnical engineers and among their specialties is dam construction. The company was engaged by Cambior Ltd. to prepare a feasibility design of a tailings storage facility at Omai. The location of the tailings pond was the valley of the Captain Mann Creek which is a tributary of the Omai River. The study contemplated the building of a north-south dam across the creek so as to abut a hill at the northern extremity, and take in the valley as part of the pond. This required a diversion of the water of the creek. Whilst the dam was under construction, to achieve this diversion, a temporary coffer dam was constructed at the northern end of the valley and a 200m long diversion conduit, made of corrugated steel and measuring 900mm in diameter, was put in place. The plan was that after the dam was built and before its commissioning, the conduit would have been sealed with concrete and grout. But it would appear that only a twenty-three meter portion was in fact sealed. There was also evidence that on two occasions during its installation, portions of the conduit had been damaged. In 1991 Knight Piesold Ltd. were awarded the contract for the construction to

supervise at least the lower portion of the dam - Stage I - and in pursuance thereof prepared the detailed designs for that stage. And although the design plans also showed the total embankment up to the proposed final elevation of 560 meters, they were never intended to be the final drawings above elevation 500 meters. This design however contained significant modifications from the design included in the 1990 report on the Feasibility study. The modifications were found to be necessary because of a revised assessment of the foundation conditions and changes in the availability of construction material from the open pit at the mine site. Among the details included were the freeboard requirements, requirements for staged construction, foundation conditions, embankment fill zones, including rock gradations after the sand filter zone, and quality control procedures for the placement of fill, stability analyses and instrumentation requirements.

The width of the embankment is about 55 meters, and above the starter dyke, i.e. Stage I, slopes away from the tailings pond. Its core consists of saprolite, a pink coloured clay, which was preferred because of its low permeability. Downstream of the core is a sand filter layer, about two meters wide, which is intended to trap any seepage from the core; and this is followed by what is described as engineering fill and waste rock. On the upstream side of the embankment, i.e., the side nearest the pond, is a layer of riprap which is intended to protect the core from erosion from winds and rain.

In order to prevent the sand from entering the engineering fill and waste rock, and so compromise the integrity of the core, gradation of the rock used is essential, and this was to be achieved by placing the smallest sizes of rock nearest the sand filter followed by varying grades of rock of increasing sizes, and finally the largest rock.

Construction of Stage I was planned in three stages, viz, IA, IB, IC and was scheduled for completion by the end of 1992, during which time it was expected that the starter dyke from elevation 485 meters to elevation 500 meters would have been completed. Detailed drawings of these stages were prepared, but by December, 1992, when Knight Piesold ceased to function as OGML's Consulting Engineers, only Stage IA and part of Stage IB were completed to the elevation 500 meters.

Actual construction work on the embankment was done by employees of OGML, and at all times they worked under the supervision of a project engineer attached to the consulting engineers. On the 21st September, 1992, the resident engineer sent a faxed letter to the head office. The portion of it that it is submitted is relevant to a determination of the issue of liability reads as follows:

> "Spec(ification) for the rockfill adjacent to filter sand requires minimum 50% passing 3" and 65% passing 6". It is fairly certain that the selected run of mine waste will not satisfy this specification.
>
> Is there room for coarsening the spec(ification)?"

Although a written response tendered is dated the 20th September, 1992, the Commission is satisfied that that date is a mistake. The response reads as follows:

> "Re: Rockfill adjacent to filter zone ANK to check filter criterion but basically we will accept the finest of the run of mine muck which should be fairly close to spec(ification) (i.e. some coarsening of spec(ification) is acceptable)"

Some time in December, 1992, OGML appointed another engineering group, Golder Associates Ltd., in place of Knight Piesold Ltd. and they appear to be the technical advisers on the construction of the embankment up to the time of the breaches in August, 1995, but did not have a resident engineer on site.

During the course of this phase of construction they were requested to, and did change the design of the pit wing dam on the south side of the pond. The reason for this change is that OGML had discovered substantial reserves of ore in the vicinity of the intended run of the pit wing dam and which could only have been mined if the size of the pond in that area was reduced. The net result was that there was a ten percent (10%) reduction in the capacity of the pond.

Certain letters that were tendered in evidence may also have some bearing on the issue of liability. The first of these is dated the 1st December, 1992, from Knight Piesold 's project engineer to OGML's Chief Engineer concerning the closure of the diversion culvert which had been used to channel water from the Captain Mann Creek away from the construction of the pond. It reads as follows:

"Date: December 1, 1992
File: 4193.F02
92-217

TO: Mr Richard Leclerc
Chief Engineer
Omai Gold Mines Ltd

FROM: Bruce Brown
Project Director
Knight and Piesold Ltd.

Dear Mr Leclerc,

Diversion Culvert Closure

Further to our discussion yesterday regarding the grouting of the remaining 33 m of the diversion culvert, there are two options to be considered. These are as follows:

Option 1: Drilling 2 HQ holes into the culvert from the embankment crest and tremie a sand cement mortar into the culvert to complete the grouting as designed. The argument for doing this is to prevent possible collapse of the culvert near the upstream face of the embankment. The design table for depth of burial for corrugated steel pipes indicates that the maximum cover for a 900 diameter, 2.8 mm wall thickness culvert is 44 m. (copy of design table is attached.) The final depth of burial for the diversion culvert will be approximately 70 m. The cost of this grouting will be

Diamond drill 24 hrs @ $75 $1800

The cost of the grout will be equivalent to the cost of the concrete not placed in November.

Option 2: Complete grouting of existing concrete plug and leave the remainder of the culvert as is. As an effective seal has been accomplished by the concrete plug already placed, and the grouting which will take place today, accept the risk that the culvert will collapse and threaten the integrity of the embankment. This risk is considered to be small as a high degree of conservatism is built into the design tables.

Please let us know which option you wish to pursue.

Yours Very Truly,

B.S. Brown PEng, Project Director

Sgd. Bruce Brown"

They recommended the second and less conservative option and that recommendation was accepted by OGML.

Then there is a faxed letter dated the 11th August, 1993, from OGML to Golder Associates Ltd. which reads:

"TO: Golder Associates Ltd. FAX NO: (604) 293 5253
ATTN: Dave Campbell DATE: 93 11th Aug.
FROM: Ray Declou PAGE 01 OF: 5
SUBJECT: Piezometers Graph Updates

Dear Mr Campbell,

Tailings pond at 506.014 Elev to date.

Dam elevation at 510.

Please let me know your views of what may have cause the sudden changes in those piezometers in the sand filter zone.

Regards

Ray."

And attached to the letter were the readings of the piezometers at varying elevation levels between 482 m and 495 m in the core. The response is dated the 17th August, 1993, and reads as follows:

"DATE: 17 Aug. 93 REF NO.
TO: OMAI GOLD MINES LTD. JOB NO. 932 1708
ATTN. RAY DECLOU FAX NO. 011 592-2-73811
PAGES TO FOLLOW:

FR: D. Campbell
RE: PIEZOMETER DATA - SAND FILTER ZONE

MESSAGE:

Dear Ray

Thank you for transmitting the piezometer data. Re your query of 11 Aug 93, regarding the recent sudden increase in the piezometric levels in the sand filter (at A3-PE1-01 & B3-PE1-01).

I expect that the rise in piezometric level is associated with disruption of the french drains that were installed within the area proposed for extension of the waste rock dump. A rise in the water levels in the region of the waste dump could be expected to result in an increase in the piezometric levels in the sand filter. The rock fill adjacent to the sand filter will act as a drain, so that piezometric levels in the sand filter zone cannot get out of control.

Dave Campbell
August 17, 1993"

Other piezometers readings sent to Golder Associates Ltd. told the same story, for on the 1st September, 1993, there is another faxed response to OGML that reads:

"DATE: September 1, 1993 JOB NO. 932-1708
TO: Omai Gold Mines Ltd. FAX NO. 011 592 2 73811
Georgetown, Guyana PAGES TO FOLLOW: 0

FR: D. Campbell
RE: PIEZOMETER DATA

MESSAGE:

Thank you for the piezometer data that you have been sending faithfully.

Over the past two months (approximately) the data show a trend of rising piezometric levels at the following piezometers:

IN SAPROLITE	IN SAND FILTER
A0-PE1-05	A3-PE1-01
B0-PE2-05	B3-PE1-01

The recent rise in piezometric levels has taken place over about the same interval of time and the piezometric elevation at each of these piezometers is now at 494 metres (approx).

The data suggest that the recent rise in the piezometric levels at each of these piezometers is related to a common event. The most likely explanation for the rise in the piezometric levels is a rise in the water levels downstream of the dam, as a result of disruption of the french drains by shear movements associated with the waste dump downstream of the EFL line.

Sgd. Dave Campbell"

On the 7th July, 1993, the readings had shown that the rock fill was dry. But thereafter the water level began to show an abrupt rise. Between December 27, 1993, and May 25, 1994, it had risen by seven meters and thereafter had levelled off. Then in May, 1995, traces of cyanide were discovered in the Fennel pit. This was also reported to Golder Associates Ltd. who concluded that it was as a result of seepage from the pond. But no further action seems to have been taken to ascertain its source.

In the opinion of the members of the Dam Review Committee the proximate cause of the failure of the embankment was a massive loss of core integrity resulting from piping, i.e., erosion of the dam fill. This means that the finer particles from one soil had moved freely under the influence of seepage forces into and through the interstitial voids of adjacent coarser soil, due to excessive disparity between particle sizes of the two soils. In other words, the gradation of rock behind the sand filter was faulty. The effect of this faulty gradation was that as the water built up in the rockfill it spread into the sand filter which became saturated. This resulted in the sand being washed away into the water and eventually entering the rockfill, thereby creating a void in the sand fill which left the core unsupported. Over time cavities or tunnels (pipes) appeared in the core and these became progressively larger and travelled upwards under the influence of continued seepage towards the pond until the final catastrophic breaches on the 19th August, 1995.

And according to the chairman of that committee the faulty construction was in Stage IA. But he came to this conclusion not from any physical examination but from photographs presented to him by OGML. He said:

> "We can't see into the dam (at) every location. What Omai has shared with us are some photographs of construction and some of these photographs show what was happening right down here at the earliest stage of this construction what (is) shown as IA. These photographs appeared to us to show the filter sand lying in the slope of this original starter dyke."
>
> And shortly afterwards he said:
>
> ".....The photographs appear to show rockfill that's very coarse being placed on this area."

But no independent evidence was led as regards the authenticity of the photographs in the sense of the real locations at which they were taken, when this could so easily have been done.

The chairman of the committee saw no significance in the rise in the water level in the rockfill, and what is somewhat surprising to the Commission was his response that the piezometers in the dam could not have given any advanced warning of the catastrophe to come.

When asked whether there was evidence of the same faulty construction on the crest of the dam he said that the Committee did not have any confirmation about the construction of the upper reaches of the dam. This is also rather surprising when one reads the Committee's interim report which was tendered in evidence. At page 7 the following appears:

> ".....By contrast construction documents and existing conditions on the dam crest indicate that pit-run rockfill of essentially unrestricted gradation was placed directly against the filter sand without adequate control of this critical feature."

And later:

> "Such gross disparity of particle sizes between the filter sand and the adjacent rockfill as can be currently seen on the dam crest should have been visibly evident to any geotechnical engineer, along with equally clear implications for filter incompatibility between the two materials."

And then there is also Mr Vick's evidence that the Committee had the opportunity to physically inspect the upper parts of the core, i.e., above the level of the slime.

Another reason given for the failure of the dam is the suspected damage or deformation of the conduit, which Mr Vick described as "a very dangerous structure". In their report the Committee stated at page 8 that:

> "The nature of corrugated metal culverts is such that they must deform (from circular to slightly oval shape) in order to develop load-carrying capacity. This raises the possibility that deformation incompatibility between the rigid grouted section and the deformable open section may have caused structural failure, or that the combined fill, slime and water loads may simply have exceeded the structural capacity of the culvert in the critical region beneath the Stage IA starter dyke. Any such structural failure would produce a void or allow soil to enter the conduit providing a direct path for concentrated seepage and causing deformation within the fill"

But the report went on to say that:

> "Structural failure of the conduit would not necessarily have been required for concentrated seepage and internal erosion to initiate and propagate along the surface of the conduit."

And in his evidence the chairman also expressed the committee's uncertainty concerning the effect of any damage to the conduit. He said that the Committee was not sure how the diversion conduit interacted with the failure mode, although they believe that there is strong evidence that it did in some way, as something had to cause the water initially to rise in the rockfill.

It was pointed out to Mr Vick that the evidence was that the embankment was being elevated at a rate that was much faster than was projected. More particularly that at the time of 'the discharges', which was two and one half years after milling operations had commenced, it was at a level 534 meters when the projections were that it should have attained that height after four and one half years of mill operations. He was asked whether such an accelerated rate of construction could have had any effect on the dam. His reply was that the rate of construction had nothing to do with the dam's failure.

In his evidence Mr Brawner, another geotechnical engineer, agreed with the findings of the Dam Review Committee that the proximate cause of the breaches was the faulty construction of the dam, and for the same reasons. He was more positive in his version that this rise in the water level in the rockfill must have been caused by some damage to or the perishing of the conduit. But he was hard put to articulate any cogent reasons for his suggestion that suspected damage to the culvert was a contributory factor. He eventually said that his reason for so concluding was that there was evidence of greater surface movement on the crest of the failed dam in the area that was directly above the culvert than in any other area. On the other hand the explanation of the Dam Review Committee on this issue seems to be more convincing. They pointed to the following facts:

1. only about twenty-three meters of the length of the culvert was filled with concrete;
2. the backfill of the upstream part of it under the dam was of sand,; and
3. the backfill of the remainder was of saprolite.

Mr Brawner also agreed with Mr Vick that an accelerated rate of construction of the dam would not have been a factor in the dam's failure.

The Commission notes that although the advice concerning the conduit was given whilst Knight Piesold Ltd. were the Consulting Engineers, it is far from clear whether it was acted upon before or after Golder Associates Ltd. had been substituted as the project's geotechnical advisers. This is an important piece of evidence as, it is only if the suggested course of action had been implemented before the latter assumed those functions, that they would be free from blame. On the other hand, if it was acted upon after they assumed their new functions, and if indeed it turns out that any damage to the conduit was the cause of the water filling up in the rockfill then they could well be held to be negligent in not bringing their independent technical and professional judgement to bear on the issue.

Evidence of Knight Piesold Ltd.

As the evidence that was led up to then seemed to be pointing the finger of blame at Knight Piesold Ltd., the Commission thought that the audi alterem partem principle demanded that the company be given an opportunity to respond. They did so in the person of Mr Jeremy Haile, the president. It is, however, somewhat unfortunate that he has no personal knowledge of the construction parameters of that portion of the dam in which his company was directly involved. In his evidence he agreed with the Dam Review Committee and its chairman as to the proximate cause of the failure of the dam. He also agreed that the seepage into the sand filter could only have occurred because of the lack of proper

gradation of the rockfill adjacent to that filter. But despite their broad areas of agreement, Mr Haile put forward a different reason for the build up of the water in the rockfill, the causa sine qua non for the failure of the dam.

Firstly, as regards seepage he points to the fact that the Dam Review Committee had overlooked that portion of the design drawings that provided for the support of the conduit by five bentonite collars placed at ten meter intervals and which were intended to prevent any such occurrence.

Secondly, he pointed to the fact that the Committee had also overlooked another possible cause for the water building up in the rockfill - a possibility that was alluded to by Golder Associates Ltd. in their responses of the 11th August and 1st September, 1993, after OGML had drawn attention to the rapid build up of water in that area of the dam. It is that the french drains, which had been installed for the specific purpose of keeping the rockfill dry, may have become blocked or been damaged. And it should be noted that there is no evidence that any effort was made to investigate that eventuality, and if found to be true, to rectify it. But the evidence of the General Manager of OGML, Mr Gourde, seems to suggest yet another reason. It is that the rockfill contained a substantial amount of saprolite and over time this could have sufficiently compacted to form an impervious layer thereby preventing the water accumulating in the rockfill from escaping downstream.

These suggested reasons aside, we still have to contend with the question of responsibility for the faulty gradation of the rockfill alongside the sand filter. Was it done at the level when Knight Piesold Ltd. were the consulting engineers, i.e. below elevation 500m? Or was it above that level when the new

consulting engineers, Golder Associates Ltd. were contracted? Or indeed, was it a fault in the whole of the dam? Mr Haile could give no direct evidence relating to the nature and quality of the construction and supervision, except to rely upon the general competence of the engineers who were always on the site.

As regards the first of the above alternatives, viz, whether Knight Piesold Ltd. were responsible, the photographs which OGML had shown to the Dam Review Committee aside, concerning which we have already commented on, the Committee pointed to the other factors in support of the view that the fault lay in the State IA construction. These are:

(1) Two graphs of envelopes that showed the gradation that Knight Piesold proposed to use in the rockfill and the sand filter; and

(2) The letter dated September 21, 1992, by Knight Piesold Ltd.'s site engineer to the head office seeking a variation of the rock specification to larger sizes than three inches to six inches.

Both these documents indicate that Knight Piesold Ltd. were conscious of the need for gradation of the rockfill adjacent to the sand filter. The question, therefore, is whether this was properly done. Mr Vick points to the fact that the graph of the range of rockfill prepared by them contemplated rock sizes as large as 600mm or about two feet. But Mr Haile responded by pointing to the fact that the range of the envelopes is from less than 30mm or one inch to the outer limit of 600mm, and that this fact by itself was no evidence that larger rock were placed adjacent to the sandfill. He expressed the view that "it (was) entirely possible to achieve proper filter compatibility of the filter sand and the transition zone from the material falling within (the) envelopes". But here again he relies on the competence of the site engineers to choose and use the best combination of rockfill.

In the Commission's view the above factors either singly or collectively do not amount to sufficient evidence to warrant a conclusion of negligence on the part of Knight Piesold in the construction of the starter dyke of the dam.

It does not appear that the agreement between OGML and Golder Associates Ltd. relating to the construction of the dam above elevation 500m required the presence of a resident engineer. And, although this was not clearly brought out in the evidence before the Commission, it would appear that the construction work was done by OGML's employees using the design drawings that had been prepared by Knight Piesold Ltd., and that the services of Golder Associates Ltd. were limited to, responding to and giving advice and assistance in the event that any difficulties or problems should arise. This arrangement could well explain the failure or omission by Golder Associates Ltd. to avail themselves of the Commission's open invitation to the public to present any cogent and relevant evidence or information that could be of assistance to the Commission in its inquiry.

If indeed OGML, which it is admitted have no specialist experience in dam construction, had indeed undertaken the construction of the dam above elevation 500m and faulty gradation work was discovered in that area of construction they would be clearly liable. And if contrary to the Commission's inference, Golder Associates Ltd. were responsible then, subject to what we have to say later about OGML's primary liability, they would also be liable for the breach and its consequences. But what is the evidence?

As we have earlier pointed out, in their interim report, the Dam Review Committee did expressly make mention of "existing conditions on the dam crest" and of "gross disparity of particle sizes between the filter sand and adjacent rockfill to be currently seen on the dam crest". The Committee also observes that that state of affairs "should have been visible evidence to any experienced geotechnical engineer for filter incompatibility between the two materials". But we have also pointed out that Mr Vick in his evidence has said that although the Committee "had the opportunity to physically inspect the upper part of the core", when asked about the condition of the 'top' of the dam his response was that "we don't have any information about the construction of the dam in the region you indicated".

Because of what would seem to be an apparent contradiction between the report and the chairman's oral evidence the Commission again finds itself unable to come to a definitive conclusion as regards liability.

Responsibility of Omai Gold Mines Limited

The evidence is that both Knight Piesold Ltd. and Golder Associates Ltd. are competent dam construction companies. The extent of Knight Piesold Ltd.'s involvement is well known, and if Golder Associates Ltd. were employed in a similar capacity then OGML cannot be faulted in either choice. But if they chose instead to construct the dam above elevation 500m themselves, then, as we have already said, they would be negligent if there was faulty construction.

Further, it may well be that OGML would be liable in negligence either wholly or in part if it can be proved that they omitted to check to ascertain whether the french drains in the rockfill were defective or damaged, as was suggested by Golder Associates Ltd. in the letter of response and to determine whether that could have been a cause for the build up of water in the rockfill.

However, this apart, and in any event, the fact of the matter is that OGML knew that the tailings pond was built as a receptacle for the storing of large quantities of a noxious substance, to wit, water with a high concentration of cyanide, and that if it were to escape, it could foreseeably cause harm to the environment, and in particular the Essequibo river, as well as result in financial loss to the residents and all other users of the river. Therefore, the company had a legal obligation to ensure that the substance did not escape; and it is no excuse that they employed competent engineers to execute the work. Therefore, in the Commission's view they would be liable for all the foreseeable loss and damage that was a direct result of the effluent entering the Essequibo River.

(b) <u>CRIMINAL LIABILITY</u>

Finally, the Commission concludes that neither OGML nor the consultants is in any way criminally responsible for the escape of the effluent, as criminal liability under the Mining Act and Regulations is based on intention to commit the act complained of or on gross recklessness whether or not the act is committed. All the evidence received by the Commission points to an unexpected and unintended, albeit, very disastrous event.

FINDINGS AND RECOMMENDATIONS

(a) FINDINGS

The Commission finds that:

1. the proximate cause of the discharges of the effluent from the tailings pond at Omai was the massive piping of the saprolite core of the dam due to the faulty construction of the gradation rockfill adjacent to the sandfill of the main dam of the pond which as a result has become useless;

2. the dam had been constructed to a total height of 44 meters by employees of OGML when the breaches occurred;

3. two separate geotechnical engineering companies, viz, Knight Piesold Ltd. and Golder Associates Ltd. were concerned in the construction; the first was supervising and overseeing the earlier stages and the second with giving advice whenever this was sought by OGML in relation to the upper portions of the dam;

4. because of the amount of water and slurry still remaining in the pond it is uncertain at what stage or stages of the dam construction the faulty work took place, and by whom done, and therefore difficult to fix liability;

5. in any event, whoever else may be liable, as OGML was responsible for bringing the noxious substance, i.e., cyanide on their 'property' they would be liable for all damage that directly results from the escape of that substance;

6. the Essequibo river is the main source of potable water for the residents along its banks and in its vicinity;

7. although the concentration of the cyanide in the discharges was the direct cause of 346 fish dying in the Omai river, due to the size and dilution capacity of the Essequibo river, at no time were the quantities or concentration of cyanide or other material, including the saprolite, injurious to health;

8. the above fact, notwithstanding the knowledge of the presence of cyanide in the rivers, coupled with the change in the colour of the water, because of the solids released by the breaches, along with the initial uncertainty as regards the concentration of poisonous contaminant, justified the hesitance and/or refusal of the riverain people to use the water;

9. there was considerable dislocation and loss to users of the Essequibo river and especially those who depended upon it for a livelihood, for which latter loss OGML would be liable in damages;

10. the company's liability would not extend to compensation for loss of employment by those who have been retrenched or for reductions in earnings by those who have been retained in the company's employ. Nor would the liability extend to compensation to the Government for revenue lost.

11. cyanide is the most economic and environmentally acceptable means of extracting gold;

12. because of the excess of rainfall over evaporation at Omai there would be need for discharge of effluent from the mine into the Essequibo river;

13. the emission of cyanide into the environment in May, 1995, was due to carelessness and is in no way connected with the August 19-24 happenings; and

14. up to the time of the discharges OGML operated a well managed and efficient gold mine and mill.

(b) RECOMMENDATIONS

The Commission can see no justifiable reason for OGML not being permitted to resume production. But the Commission recommends that:

1. as a condition precedent thereto, the integrity of the construction of the second tailings pond, permission for which has been granted by the Government, be ascertained and confirmed by an independent geotechnical source, the cost of which must be borne by OGML;

2. in order to limit the concentration of cyanide and other noxious substances to be so released into the environment the company must undertake to instal as early as possible and before any releases take place, the following prophylactic aids:

    1) a hydrogen peroxide oxidation facility;

    2) activated carbon columns;

    3) two hundred multiport defuser; and

    4) a clarifier.

3. OGML and the Government should institute a regime of testing, and if successful, implementing alternative systems which would improve degradation of cyanide before its release into the receiving waters;

4. the Government and OGML should jointly plan and implement a protocol for educating the populace to a sensible and rational understanding of cyanide and its effects;

5. as a priority the Government should set about implementing environmental protection legislation which should include a regulatory agency vested with executive authority to grant and revoke mining licences and to monitor compliance with all environmental and other obligations;

6. tests on a regular and continuing basis should be undertaken by OGML of the quantities and concentrations of noxious substances in the new tailings pond, and of both surface and ground water on the property leased as well as surface and subsurface waters of the Omai and Essequibo rivers;

7. as an adjunct to the regulatory agency, the Government should establish, equip and staff adequate laboratory facilities with capabilities for undertaking all necessary scientific and other tests so as to ensure compliance by mining enterprises with all laws and agreements and especially as regards the quality and rate of discharge of effluents into the environment;

8. the creation of a national disaster response agency which should include representatives from the mining community, environmentalists and representatives from residents in those areas that may be adversely affected by emissions;

9. OGML should prepare and cost for approval by the regulating agency a reclamation and closure plan within an agreed period of time and with a timetable, during the active life of the mine, within which, such reclamation and/or closures would be completed;

10. a first step in this procedure must be the detoxification and reclamation of the failed tailings pond; and

11. the present bond should be re-negotiated and adjustments made to take account of the cost of reclamation and ultimate closure of the mine.

MR KENNETH GEORGE, O.R. - Chairman

.....

MRS YOLANDE FOO

.....

MR DENNIS HANOMAN SINGH

.....

MR ISHMAEL BACCHUS

.....

COL. MICHAEL ATHERLY

.....

MR LORRIS GANPATSINGH - Counsel/Legal Adviser to Commission of Inquiry

MRS ROSEMARY N. BENJAMIN-NOBLE - Secretary

ADDENDUM
TERMS OF REFERENCE

1. to receive representation upon and inquire into:

(a) the circumstances relating to the cyanide discharge into the Omai and Essequibo rivers on the night of August 18, 1995, and subsequently by Omai Gold Mines Ltd., a company incorporated in Guyana under the Companies Act, Cap. 89:01, (hereinafter referred to as OGML) and the incidents and effects thereof;

(b) the liability for the discharge and the consequences thereof;

(c) the effects of the cyanide discharge on the environment and in particular on the well being of employees at the mining site of OGML;

(d) the adequacy, design and management of the industrial facilities at OGML, with particular reference to the tailings pond, as they relate to the cause of the discharge;

(e) the safety measures and procedures in relation thereto and disaster preparedness plans in force at OGML on, preceding, and following August 18, 1995, and the extent to which they were applied to meet the discharge;

(f) any other matters, including any previous discharges which are relevant, or incidental to a determination of the foregoing or considered necessary therefor; and

2. to submit a report of findings and make recommendations:

(a) on the remedial measures to be taken in respect of the relevant industrial designs of OGML and otherwise that would prevent a recurrence of such a discharge;

(b) in particular on preventive measures or technologies which ought to be adopted to avoid the recurrence of a cyanide spill or similar happening;

(c) to ensure the integrity of the environment and ecological systems as well as the health, safety and well being of the employees of OGML and the riverain population of the Omai and Essequibo rivers, and other affected areas.